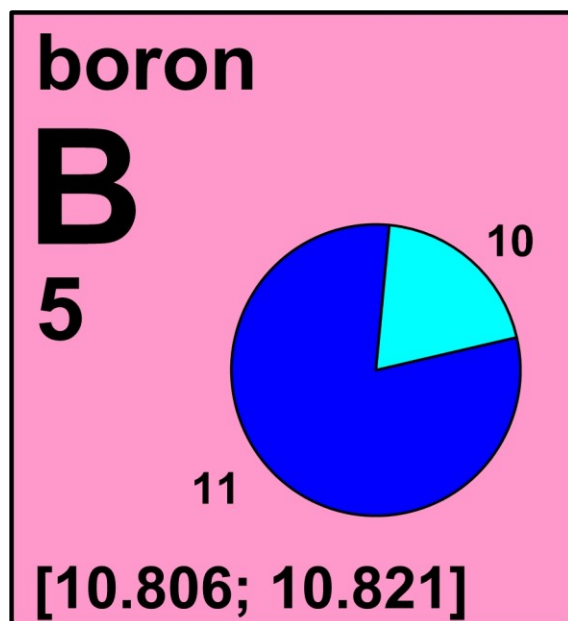


boron



| Stable isotope | Atomic mass* | Mole fraction |
|-----------------|--------------|---------------|
| ^{10}B | 10.012 937 | 0.199 |
| ^{11}B | 11.009 3054 | 0.801 |

* Atomic mass given in unified atomic mass units, u.

Half-life of radioactive isotope

Less than 1 second
Between 1 second and 1 hour
Greater than 1 hour



| | | | | | | | | | |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| ^6B | ^7B | ^8B | ^9B | ^{10}B | ^{11}B | ^{12}B | ^{13}B | ^{14}B | ^{15}B |
| ^{16}B | ^{17}B | ^{18}B | ^{19}B | | | | | | |

Important applications of stable and/or radioactive isotopes

Isotopes in medicine

- ^{10}B has a high thermal neutron cross-section and it can readily absorb neutrons via the following reaction, $^{10}\text{B} + ^1_0\text{n} \rightarrow ^7_3\text{Li} + \alpha$. The resulting alpha particles from this reaction carry away relatively large amounts of kinetic energy, which are useful for the treatment of malignant tumors in cancer patients.
- ^{10}B and ^{11}B are both used to study boron metabolism as food labels.

Isotopes in nuclear physics

- The large thermal neutron absorption section of ^{10}B makes this isotope useful for counting neutrons.

Isotopes in tracer studies

- The relative abundance of ^{10}B and ^{11}B can be used in a variety of environmental tracing applications. The amount of ^{10}B or ^{11}B in a water sample depends on the source of the

water and region through which the water flows. Different sources may have their own distinct boron isotope composition, i.e. seawater versus continental sources.

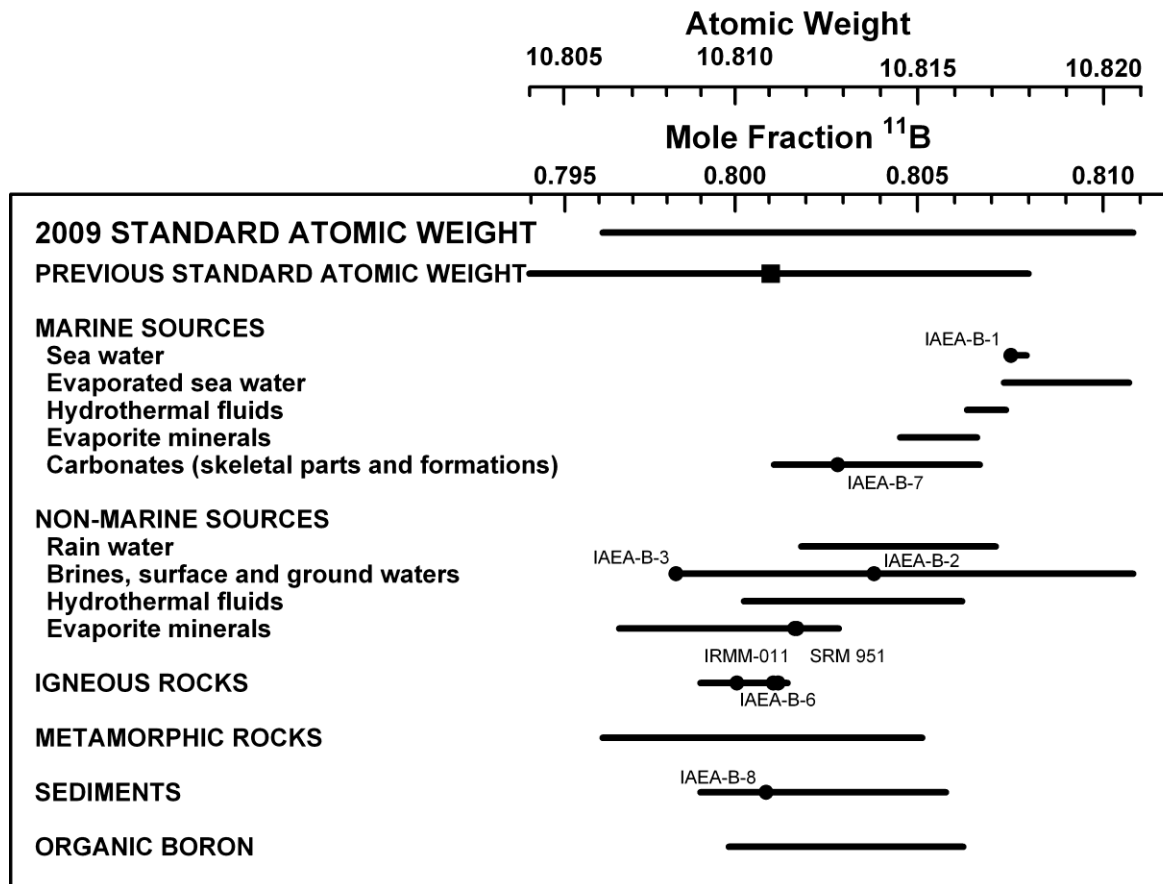


Figure 1: Variation in atomic weight with isotopic composition of selected boron-bearing materials (modified from [14, 15]). Isotopic reference materials are designated by solid black circles. The previous (2007) standard atomic weight of boron was 10.811(7). The atomic-weight uncertainty of the best measurement of isotopic abundance [7, 37] is approximately ± 0.0002 , which is 35 times smaller than the uncertainty of the 2007 standard atomic weight [4]. (Figure Source: A. Vengosh).

Isotopes in industry

- 1) ^{10}B in the form of boric acid is used in pressurized water reactors as a chemical shim.
- 2) ^{10}B in the form of sodium pentaborate is used in boiling water reactors for standby liquid control systems.

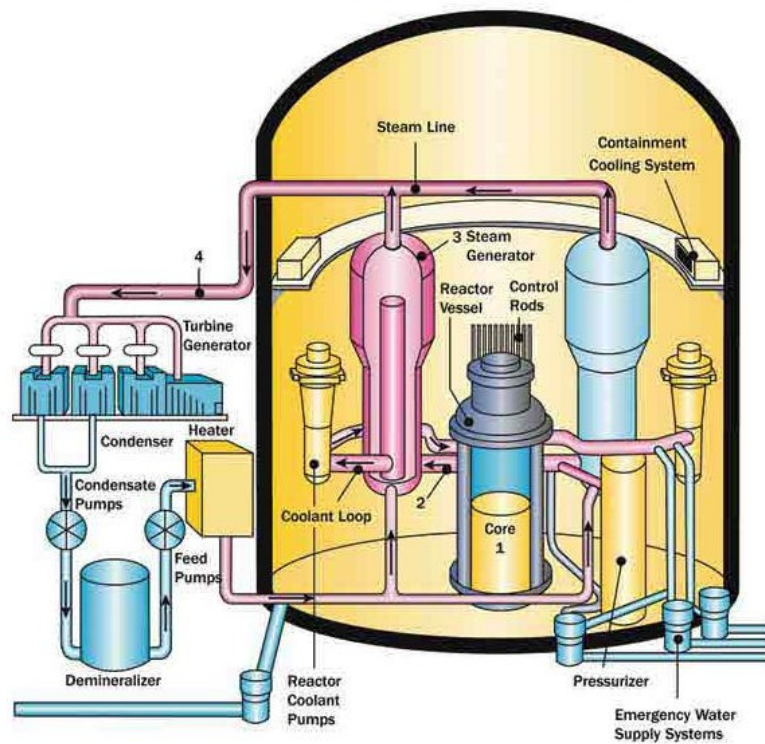


Figure 2: Diagram of a typical pressurized water reactor. (Diagram Source: U.S. Nuclear Regulatory Commission).